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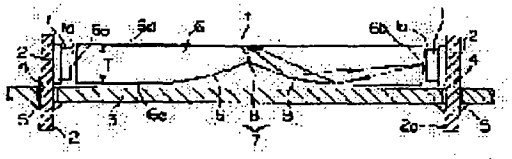
(54) LIGHTING MODULE

(57)Abstract:
PURPOSE: To provide a lighting module capable of lighting a display element with uniform illuminating light without the dispersion of illuminating light from a light emitting element which is made incident on a light transmission plate on the lighting surface of the light transmission plate.
CONSTITUTION: In this lighting module, one or more pairs of light emitting lements 1 are arranged to be opposed to the opposed end faces of the light transmission plate 6 consisting of light transmissive resin, and the display element is lighted with light from the light emitting element 1 which is made incident from the side surface 6b of the light transmission plate 6 from the lighting surface 6a of the light transmission plate 6 formed in parallel with the optical axis direction of the light emitting element 1. A r cessed reflection part 7 is formed nearly in the center part of the surface 6c of the light transmission plate 6 on an opposite side to the lighting surface 6a thereof, and a part between the edge part and the deepest part 8 of the reflection part 7 is formed to be a projected curved surface 9.



LEGAL STATUS

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DETAILED DESCRIPTION

[Detail d Description of the Invention]
[0001]
[Industrial Application] this invention is used for illumination of the display of light-transmission nature, especially a light-transmission nature liquid crystal display, and relates to a suitable illumination module.
[0002]
[Description of the Prior Art] Various kinds of display using the liquid crystal display element which generally has light-transmission nature functions as the ability of the circumference to be able to recognize the content of a display by the reflected light like [under the environment where a twist is also bright] the usual reflected type liquid crystal display to some extent, and has the composition of functioning as the ability of the content of a display being recognized by the lighting light of the illumination module which is the illumination light source with which the circumferences, such as night, w re installed behind the liquid crystal display element when a twist was also dark
[0003] The Light Emitting Diode type which uses a light emitting diode (Light Emitting Diode) element for the aforementioned illumination module as a light emitting device, EL type which uses an electroluminescence (EL) element as a light emitting device are known. While arranging a light guide plate behind the back light type illumination module which arrang s a Light Emitting Diode element behind a display device, and illuminates a display device directly, and a display d vice, a Light Emitting Diode element is arranged to the method of both sides of a light guide plate, and there is a side light type illumination module which illuminates a display device indirectly by the light of the Light Emitting Diode element which carried out incidence to the light guide plate in a Light Emitting Diode type. Among these, the side light type illumination module is useful in order to attain thin shape-ization of a product, and it is an illumination module used well in recent years.
[0004] Below, a conventional side light type illumination module is explained. Drawing 4 and drawing 5 are drawings showing a side light type illumination module. This illumination module makes the field where one pair of printed wired boards 2 which mount d two Light Emitting Diode elements 1, respectively mounted this Light Emitting Diode element 1 as shown in drawing 4 counter, it is arranged, and the base printed wired board 3 is arranged between the printed wired boards 2 of this couple. as shown in drawing 4 , a hole 4 is formed in the method of both sides of the base printed wired board 3 at two places, respectively, and leg 2a for combination of each printed wired board 2 inserts into this hole 4 -- having -- these printed wired boards 2 and the base printed wired board 3 -- a hole -- it is fixed with the solder 5 of the circumference [4] section And a KO character type angle member is constituted by the combination of these printed wired boards 2 and the base printed wired board 3, and wearing support of the light guide plate 6 which consists of a light-transmission nature resin on the base printed wired board 3 is carried out.
[0005] A display device is arranged in the front face of the light guide plate 6 of the aforementioned illumination module, and is indirectly illuminated by the light of the Light Emitting Diode element 1 as follows. That is, the light of the Light Emitting Diode element 1 carries out incidence from side 6b of a light guide plate 6, and this incident light illuminates a display device as a lighting light from illumination side 6a of the light guide plate 6 formed in the direction of an optical axis of the Light Emitting Diode element 1, and parallel. Generally, as what consists of a package element of a chip configuration is used and the Light Emitting Diode element 1 is shown in drawing 4 and drawing 5 , since the quantity of light distribution becom s the highest in upper surface 1a of the package, the Light Emitting Diode element 1 is arranged so that light may be introduced into side 6b of a light guide plate 6 from upper surface 1a of the Light Emitting Diode element 1.
[0006]
[Probl m(s) to be Solved by the Invention] When a display device is illuminated with an illumination module as mentioned above, dispersion produces the luminosity of the lighting light of the Light Emitting Diode element 1 which carried out incidence to the light guide plate 6 with the position on a light guide plate 6. That is, in drawing 5 , there is a problem that a big difference arises inevitably in a luminosity, in the field B near the Light Emitting Diode element 1 of a light guide plate 6, and the field C distant from the Light Emitting Diode element 1. Although it is remarkable when thin and thickness T of a light guide plate 6 is [thickness T] 1.5mm or less, since a miniaturization and thin-shape-izing of a product are requir d in recent years, especially as for this problem, effective solution is desired.
[0007] In order to avoid such a problem, various devices are made so that the lighting light of the Light Emitting Diode element 1 which carried out incidence to the light guide plate 6 may diffuse. That is, the method of applying a fluorescence nature paint and a white paint, i.e., a paint with the high rate of a light reflex, to partial 3a by which the light guide plate 6 on the base print d wired board 3 is arranged, the method of preparing a fine blemish in base section 6c of a light guide plate 6 by hairline processing, and making it reflect irregularly on it, or the method of forming the diffusing surface in base section 6c of a light guide plate 6 by mat processing is made. However, there is un-arranging [that lighting light also fully becomes the fall of character discernment nature and the cause of the tiredness of an eye to the field C of drawing 5 also by these methods since dispersion in the luminosity of Field B and Fi ld C still remains by not being spread, incidence and].

[0008] this invention was made in view of such a situation, and it aims at offering the illumination module which can illuminate a display device by uniform lighting light, without the lighting light of the light emitting device by which incidence was carried out to the light guide plate varying in the illumination side of a light guide plate.

[0009]
[Means for Solving the Problem] By the illumination module according to claim 1, as the light source, the light emitting device of a couple counters and is arranged. Betwe n the light emitting devices of this couple, the light guide plate which consists of a light-transmission nature resin is arranged. In the illumination module with which the light of the afor mentioned light emitting device which carried out incidence from the side of this light guide plate illuminated the display device from the dir ction of an optical axis of the aforementioned light mitting device, and the illumination side of the light guide plate formed in parallel While forming the concave reflective section in the abbreviation center section of this field to the illumination side of the aforementioned light guide plate in the fi ld of an opposite side, this reflective section made it the solution means of the aforemention d technical problem to form b tween a marginal part and the deepest sections in a convex surface.
[0010] By the illumination module according to claim 2, it made for the distance between the field of an opposite side and the deepest section of the aforementioned reflective section to be about 10% of the width of face of a light guide plate, and for the length in the direction of an optical axis of the aforementioned reflective section to be about 60% of the length of the direction of an optical axis of the aforementioned light guide plate into the solution means of the aforementioned technical problem to the illumination side of the aforementioned light guide plate in the illumination module according to claim 1.
[0011] By the illumination module according to claim 3, the amount of devotion of the reflective section formed in the afor mentioned light guide plate made it to have considered as 5% – 20% of range of the thickness of the aforementioned light guide plate the solution means of the aforementioned technical problem in the illumination module according to claim 1 or 2.
[0012] By the illumination module according to claim 4, it made to have located the optical axis of the aforementioned light emitting device between the center line of the thickness of the aforementioned light guide plate, and the center line of the thickness of the light guide plate in the deepest section of the aforementioned reflective section into the solution means of th aforementioned technical problem in the illumination module according to claim 1 to 3.
[0013] By the illumination module according to claim 5, the deepest section of the aforementioned reflective section made it to be formed in the concave curved surface which continues from the convex surface of the reflective section the solution means of the aforementioned technical problem in the illumination module according to claim 1 to 4.
[0014]
[Function] By the illumination module according to claim 1, a light guide plate is arranged between the light emitting devices of a couple, and the light of a light emitting device carries out incidence from the side of a light guide plate. It is reflected on the curved surface of the reflective section formed in the abbreviation center section of the field of an opposite side to the illumination side, and this reflected light carries out outgoing radiation of a part of light which carried out incidence to the light guide plate from the center section of the illumination side. When between the marginal part of the reflective section and the deepest sections is formed in a concave curved surface, the light irradiated by the reflective section is scattered about. On the other hand, when between the marginal part of the reflective section and the deepest sections is form d in a convex surface, the whole light irradiated by the reflective section is condensed to the position of a light guide plate. Moreover, since the paint with the high rate of a light reflex is applied to the front face of the reflective section at least, in the curved surface of the reflective section, the reflection factor of light becomes high.
[0015] An illumination module according to claim 2 condenses the light to which incidence was carried out from the side of a light guide plate and which was irradiated by the reflective section in the illumination side center section.
[0016] The depth of the reflective section by which an illumination module according to claim 3 is formed in a light guide plate is within the limits of 5% – 20% of the thickness of a light guide plate. There is almost no light in which the depth of the reflective section is reflected on the curved surface of the reflective section in the case of 5% or less of the thickness of a light guide plate. Moreover, since the reflective section is deep in the case of 20% or more of the thickness of a light guide plat , the depth of the reflective section is scattered all over an illumination side, without the reflected light concentrating on the center section of the illumination side.
[0017] An illumination module according to claim 4 is located between the center lines of the thickness of a light guide plate [in / the deepest section of the center line of the thickness of a light guide plate, and the reflective section / in the optical axis of a light emitting device]. Although the light reflected on the curved surface of the reflective section will be mod rately obtained if the optical axis of a light emitting device is in the aforementioned range, if the above is out of range, ther is little reflected light obtained on the curved surface of the reflective section.
[0018] Illumination modules according to claim 5 are appropriately scattered about on a concave curved surface, distribute the light irradiated by the deepest section from a light emitting device to the whole illumination side, and make the illuminance of the whole illumination side stability without maldistribution.
[0019]
[Example] Hereafter, a drawing explains one example of the illumination module by this invention. In addition, the same sign shows the same component as the aforementioned drawing. Drawing 1 or drawing 3 is drawing showing one example of this invention. The printed wired board 2 of the couple in which two Light Emitting Diode elements (light emitting device) 1 which are the light source were mounted at a time, respectively makes the field where the Light Emitting Diode element 1 was mounted counter, and this illumination module is arranged, as shown in drawing 1 . The base printed wired board 3 is arranged b twe n the printed wired boards 2 of this couple, and the hole 4 is formed in the method of both sides of this bas printed wired board 3 at two places, respectively. as shown in drawing 1 , whil leg 2a for combination of a printed wired board 2 is insert d into these holes 4, respectively — a hole — the base printed wired board 3 and the printed wired board 2 of a couple are being fixed with the solder 5 of the circumference [4] section A KO character type angle member is constituted by the combination of the printed wired board 2 of th se couples, and the base printed wired board 3, and wearing support of the light guide plate 6 which consists of a light-transmission nature resin on the base printed wired board 3 is carried out. In addition, about the base printed wired board 3, since various configurations can be taken, the configuration is not specified.
[0020] Illumination side 6a for the aforementioned light guide plate 6 illuminating a display device while the side 6b counters

the Light Emitting Diode elem nt 1, as thickness T is 0.5mm – about 1.5mm and it is shown in drawing 1 is formed in the dir ction of an optical axis of the Light Emitting Diode lement 1, and parallel. The reflective section 7 of a curved-surface configuration is formed in the abbr viation center section of this field 6c at this illumination side 6a and fi ld 6c of an opposite side. This reflective section 7 is an indented configuration from which the center section is th deepest section 8, and it has come to form b tween an equidistant portion and the deepest sections 8 in a convex surface 9 from this deepest section 8. The aforementioned convex surface 9 is the configuration which forms a part of spherical surface of cross s ctional view and radius-of-curvature regularity.

[0021] As for the depth of the afor mentioned refl ctive section 7, it is desirable that it is within the limits of 5% – 20% of thickness T of a light guide plate 6. Moreover, it is desirable that it is within the limits whose forming face product of this reflective section 7 is 20% – 80% of the area of field 6c of a light guide plate 6. Furthermore, as for the aforem ntioned conv x surface 9, it is advantageous on molding that it is fixed radius of curvature, and it is desirable. And the white paint (paint with the high rate of a light reflex) is applied to the whole field 6c containing the convex surface 9 of the reflective s ction 7. Moreover, the optical axis of the Light Emitting Diode element 1 on a printed wired board 2 is arranged so that it may b located between the center line of thickness T of a light guide plate 6, and the center line of thickness t of the light guide plate 6 in the deepest section 8 of the reflective section 7.

[0022] In addition, as shown in drawing 3 , the deepest section 8 is formed in the concave curved surface which follows the aforementioned convex surface 9.

[0023] When illuminating a light-transmission nature liquid crystal display using the illumination module of this example, as shown in drawing 1 , the light which the light of the Light Emitting Diode element 1 carried out [light] incidence from side 6b of a light guide plate 6, and carried out incidence to the light guide plate 6 turns into lighting light, and illuminates the light-transmission nature liquid crystal display (illustration abbreviation) arranged in the front face of illumination side 6a. At this time, it is reflected by the reflective section 7, a part of light by which incidence was carried out to the light guide plate 6 progresses in the direction of an arrow, and outgoing radiation is carried out from illumination side 6a. Although reflection of the incident light in the aforementioned reflective section 7 reflects the incident light irradiated by the convex surface 9 with angle of reflection equal to an incident angle, since a convex surface 9 is a concave surface, it condenses the r flective direction of the reflected light at a rate according to the radius of curvature of a convex surface 9 to illumination side 6a. The condensing position of an incident light is the center section of illumination side 6a, and the reflective section 7 can spread lighting light round the whole illumination side 6a uniformly by holding the candela value of the center section of illumination side 6a.

[0024] Moreover, since the illumination module of this example is led to the center section of illumination side 6a, without making a way distribute the incident light scattered about in the direction of field 6c outside illumination side 6a, equalization of the lighting light in illumination side 6a is efficiently easy for it. Moreover, by molding of a convex surface 9, since a setup of a condensing position is also easy, even if it is the case where opposite arrangement of the Light Emitting Diode element 1 is not carried out at the both-sides section of a light guide plate 6, by setting a condensing position as the position of the purpose of illumination side 6a, equalization of the lighting light to illumination side 6a can be attained easily, and the flexibility of a design of an illumination module improves. In addition, since the portions by which the reflected light of the deepest section 8 of illumination side 6a is irradiated are appropriately scattered about by the concave curved surface of the deepest section 8, without being completed by the reflected light, the whole illumination side 6a is illuminated with a fixed illuminance.

[0025] The illumination module of the aforementioned composition is manufactured to below, and the example of an experiment which measured the lighting light in illumination side 6a of the light guide plate 6 is described in it. 30mm and thickness T formed [Width W / 40mm and Length D] the example light guide plate 6 of an experiment in 1.5mm. The depth of the deepest section 8 formed in 0.3mm (20% with a thickness [of a light guide plate 6] of 1.5mm), and the diameter formed the reflective section 7 of field 6c of a light guide plate 6 in 30mm (59% of the area of field 6c). And the white paint was applied all over field 6c of this light guide plate. Moreover, the interval X of two Light Emitting Diode elem nts 1 on each printed wired board 2 formed so that the distance Y between 10mm and two printed wired boards 2 might be set to 44mm. As a Light Emitting Diode element 1, the package element of a chip configuration was used with the Light Emitting Diode element of the yellow green of a high brightness type color tone. The Light Emitting Diode element 1 pass d 10mA current, and made it the energization state.

[0026] Thickness T of a light guide plate 6 is 3.0mm, and the illumination module made into criteria is an illumination module which the reflective section 7 was not formed in field 6c, and also was manufactured as the same conditions as the above, and sets to 1.0 the photometry numeric value (candela value) which used the whole illumination side 6a in this case as the target. And when the candela value of illumination side 6a of a light guide plate 6 was measured by the illumination module of the aforementioned example of an experiment, the field B of drawing 2 was 1.35 and Field C was 0.70. In addition, as comparative experiments, thickness T of a light guide plate 6 is 3.0mm and 1.5mm, and the candela value of illumination side 6a was measured about the illumination module of the same conditions as the example of an experiment, respectively except not forming the reflective section 7 in field 6c of a light guide plate 6. When thickness T of a light guide plate 6 was 3.0mm, the field B of drawing 2 was 1.35 and Field C was 0.85. When thickness T of a light guide plate 6 was 1.5mm, the fi ld B of drawing 2 was 1.30 and Field C was 0.42. Even when the illumination module of this example makes thickness T of a light guide plate 6 thinner than the aforementioned example of an experiment, it turns out that the candela value in the illumination side 6a is acquired for thickness T of a light guide plate 6 by the same grade as the case of b ing thick, and dispersion in lighting light is a few illumination module.

[0027] In addition, you may constitute a KO character type angle member by combining with one the printed wired board 2 in which the base printed wired board 3 and the Light Emitting Diode element 1 other than composition of having been shown in drawing 1 or drawing 3 are mounted with a flexible printed wiring board as structure of an illumination module, bending in a flexible printed wiring board portion, and fixing.

[0028]

[Effect of the Invention] The light guide plate with which an illumination module according to claim 1 consists of a light-transmission nature resin between th light emitting devices which the couple countered and have been arranged is

arranged. In the illumination module with which the light of the light emitting device which carried out incidence from the side of a light guide plate illuminated the display device from the direction of an optical axis of a light emitting device, and the illumination side of the light guide plate formed in parall l While the concave reflective section is formed in the abbreviation center section of this field to the illumination side of the afor mentioned light guide plate in the field of an opposite side, this reflective s ction is characterized by forming b tween a edge and the deepest sections in a convex surface. Therefore, a uniform lighting light is obtained, without a luminosity varying in th whole illumination side, since it is reflect d by the paint with the high rate of a light reflex applied to the front face of the reflective section and is condensed by distribution or the position, while a part of light of the light emitting device which carried out incidence from the side of a light guide plate is reflected on the curved surface of the r flective section. And since a display device is illuminated with a uniform lighting light, in display, character discernment nature is good and does not produce the tiredness of an eye, either.

[0029] In an illumination module according to claim 1, to the illumination side of the aforementioned light guide plate, the distance between the field of an opposite side and the deepest section of the aforementioned reflective section is about 10% of the width of face of a light guide plate, and, as for an illumination module according to claim 2, length in the direction of an optical axis of the aforementioned reflective section is characterized by ****** by about 60% of the length of the direction of an optical axis of the aforementioned light guide plate. Therefore, the reflective section condenses mostly the incident light reflected on the aforementioned concave curved surface in the center section of the illumination side, and goes up the candela value of the center section of the illumination side efficiently.

[0030] In an illumination module according to claim 1 or 2, the depth of the reflective section of an illumination module according to claim 3 is within the limits of 5% – 20% of the thickness of a light guide plate. Therefore, while the light reflect d in the reflective section is obtained moderately, when the reflected light concentrates on the center section of the illumination side, the center section of the illumination side distant from a light emitting device becomes bright, and the whole illumination side becomes a uniform luminosity.

[0031] In a claim 1 or an illumination module given in three, since the optical axis of a light emitting device is located between the center line of the thickness of a light guide plate, and the center line of the thickness of the light guide plate in the deepest section of the reflective section, in the reflective section, an incident light reflects an illumination module according to claim 4 moderately with the desired quantity of light. Therefore, the center section of dispersion of the illumination side is lost to the luminosity of the increase of a luminosity, and an illumination side by the reflected light.

[0032] By the illumination module according to claim 5, in an illumination module according to claim 1 to 4, since the d pest section of the aforementioned reflective section is characterized by being formed in the concave curved surface which continues from the convex surface of the reflective section, also in the deepest section of the reflective section, it can distribute without being completed by light and the whole illumination side can be illuminated with the stable illuminance.

[Translation done.]

* NOTICES *

1. This document has been translated by computer.So the translation may not reflect the original precis ly.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] As the light source, the light emitting device of a couple counters, it is arranged, and the light guide plate which consists of a light-transmission nature resin is arranged between the light emitting devices of this couple. In the illumination module with which the light of the aforementioned light emitting device which carried out incidence from the side of this light guide plate illuminated the display device from the direction of an optical axis of the aforementioned light emitting device, and the illumination side of the light guide plate formed in parallel This reflective section is an illumination module characterized by forming between a edge and the deepest sections in a convex surface while the concave reflective section is formed in the abbreviation center section of this field to the illumination side of the aforementioned light guide plate in the field of an opposite side.
[Claim 2] The illumination module characterized by for the distance between the field of an opposite side and the deepest section of the aforementioned reflective section being about 10% of the width of face of a light guide plate, and the length in the direction of an optical axis of the aforementioned reflective section being about 60% of the length of the direction of an optical axis of the aforementioned light guide plate to the illumination side of the aforementioned light guide plate in an illumination module according to claim 1.
[Claim 3] The illumination module with which the amount of devotion of the reflective section formed in the aforementioned light guide plate is characterized by being 5% - 20% of range of the thickness of the aforementioned light guide plate in an illumination module according to claim 1 or 2.
[Claim 4] The illumination module with which the optical axis of the aforementioned light emitting device is characterized by being located between the center line of the thickness of the aforementioned light guide plate, and the center line of the thickness of the light guide plate in the deepest section of the aforementioned reflective section in an illumination module according to claim 1 to 3.
[Claim 5] The illumination module characterized by forming the deepest section of the aforementioned reflective section in the concave curved surface which continues from the convex surface of the reflective section in an illumination module according to claim 1 to 4.

[Translation done.]

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DESCRIPTION OF DRAWINGS

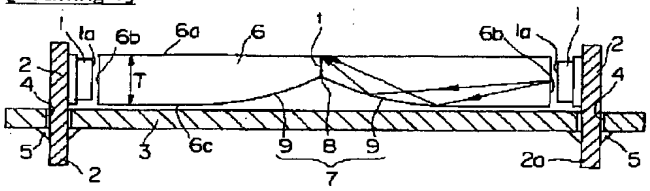
[Brief Description of the Drawings]
[Drawing 1] It is a cross section in AB line of drawing 2 of the illumination module shown as one example of this invention.
[Drawing 2] It is the plan of this illumination module.
[Drawing 3] It is the expanded sectional view showing the deepest section of the reflective section of this illumination module.
[Drawing 4] It is a cross section in AB line of drawing 5 of the conventional illumination module.
[Drawing 5] It is the plan of this illumination module.
[Description of Notations]
1 Light Emitting Diode Element
6 Light Guide Plate
6a Illumination side
7 Reflective Section
8 The D pest Section
9 Convex Surface

[Translation done.]

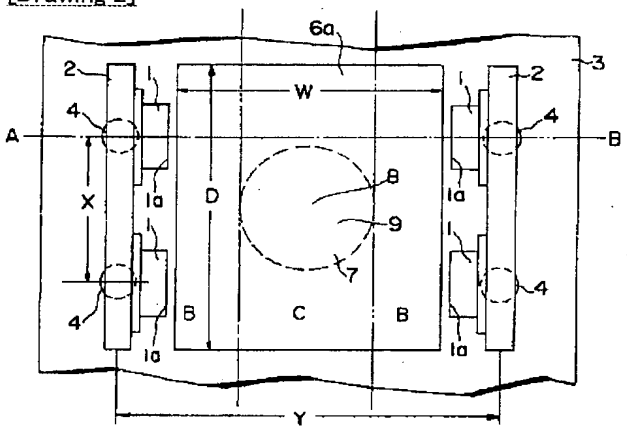
* NOTICES *

DRAWINGS

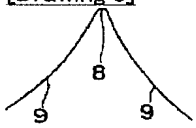
[Drawing 1]



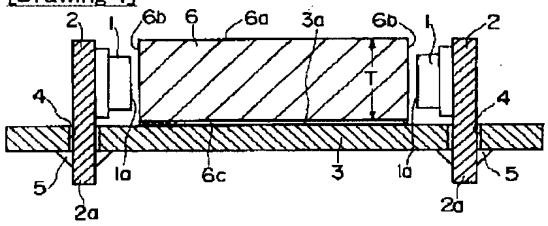
[Drawing 2]



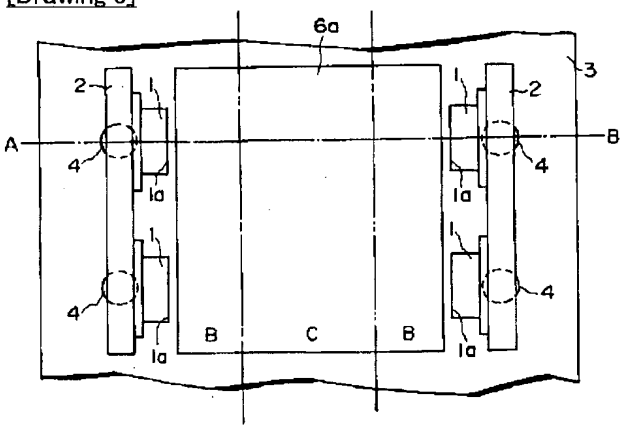
[Drawing 3]



[Drawing 4]



[Drawing 5]



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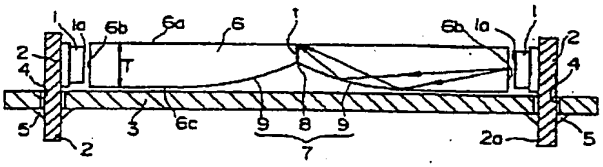
(54)【発明の名称】　照光モジュール

(57)【要約】

【目的】　導光板６に入射された発光素子１の照明光が、導光板６の照光面６ａにおいてばらつくことなく、均一な照明光により表示素子を照光することができる照光モジュールを提供する。

【構成】　光透過性樹脂からなる導光板６の対向する端面に発光素子１を一対位上対向配置し、導光板６の側面６ｂから入射した発光素子１の光が、発光素子１の光軸方向と平行に形成された導光板６の照光面６ａから表示素子を照光する照光モジュールにおいて、前記導光板６の照光面６ａに対して反対側の面６ｃには、該面６ｃの略中央部に凹型の反射部７が形成されるとともに、該反射部７は縁部と最深部８との間が凸曲面９に形成されている



【特許請求の範囲】
【請求項１】　光源として一対の発光素子が対向して配置され、該一対の発光素子の間には光透過性樹脂からなる導光板が配置され、該導光板の側面から入射した前記発光素子の光が、前記発光素子の光軸方向と平行に形成された導光板の照光面から表示素子を照光するようにした照光モジュールにおいて、
前記導光板の照光面に対して反対側の面には、該面の略中央部に凹型の反射部が形成されるとともに、該反射部は縁部と最深部との間が凸曲面に形成されていることを特徴とする照光モジュール。
【請求項２】　請求項１記載の照光モジュールにおいて、前記導光板の照光面に対して反対側の面と、前記反射部の最深部との間の距離が導光板の幅の約１０％であり、かつ前記反射部の光軸方向における長さが前記導光板の光軸方向の長さの約６０％であることを特徴とする照光モジュール。
【請求項３】　請求項１又は２に記載の照光モジュールにおいて、前記導光板に形成される反射部の没入量が、前記導光板の厚さの５％～２０％の範囲であることを特徴とする照光モジュール。
【請求項４】　請求項１ないし３のいずれかに記載の照光モジュールにおいて、前記発光素子の光軸が、前記導光板の厚さの中心線と、前記反射部の最深部における導光板の厚さの中心線との間に位置することを特徴とする照光モジュール。
【請求項５】　請求項１ないし４のいずれかに記載の照光モジュールにおいて、前記反射部の最深部が、反射部の凸曲面から連続する凹曲面に形成されていることを特徴とする照光モジュール。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は、光透過性の表示装置、特に光透過性液晶表示装置の照光に使用して好適な照光モジュールに関するものである。
【０００２】
【従来の技術】一般に、光透過性を有する液晶表示素子を用いた各種の表示装置は、周囲がある程度よりも明るい環境のもとでは、通常の反射型液晶表示装置と同様に反射光により表示内容を認識し得るように機能し、夜間など周囲がある程度よりも暗い場合には、液晶表示素子の背後に設置された照光光源である照光モジュールの照明光により表示内容を認識し得るように機能する構成となっている。
【０００３】前記の照光モジュールには、発光ダイオード（ＬＥＤ）素子を発光素子として使用するＬＥＤタイプと、エレクトロルミネッセンス（ＥＬ）素子を発光素子として使用するＥＬタイプ等が知られている。ＬＥＤタイプには、ＬＥＤ素子を表示素子の背後に配置して表示素子を直接照光するバックライト型の照光モジュールと、表示素子の背後に導光板を配置するとともにＬＥＤ素子を導光板の両側方に配置して、導光板に入射したＬＥＤ素子の光により間接的に表示素子を照光するサイドライト型の照光モジュールとがある。このうち、サイドライト型の照光モジュールは製品の薄型化を図るために有用であり、近年よく利用される照光モジュールである。
【０００４】以下に、従来のサイドライト型の照光モジュールについて説明する。図４、図５はサイドライト型の照光モジュールを示す図である。この照光モジュールは、図４に示すように、それぞれ２個のＬＥＤ素子１を実装した１対のプリント配線板２が、該ＬＥＤ素子１を実装した面を対向させて配置され、この一対のプリント配線板２の間にベースプリント配線板３が配置されている。図４に示すように、ベースプリント配線板３の両側方にはそれぞれ２箇所に孔４が形成され、この孔４内に各プリント配線板２の結合用脚部２ａが挿入され、これらプリント配線板２とベースプリント配線板３とは孔４周囲部の半田５により固定されている。そして、これらプリント配線板２とベースプリント配線板３との組み合せによりコ字型のアングル部材が構成され、ベースプリント配線板３上に光透過性樹脂からなる導光板６が装着支持されている。
【０００５】表示素子は、前記の照光モジュールの導光板６の前面に配置され、以下のようにＬＥＤ素子１の光により間接的に照光される。即ち、ＬＥＤ素子１の光が導光板６の側面６ｂから入射し、この入射光がＬＥＤ素子１の光軸方向と平行に形成された導光板６の照光面６ａからの照明光として表示素子を照光するようになっている。一般に、ＬＥＤ素子１は、チップ形状のパッケージ素子からなるものが使用され、図４および図５に示すように、ＬＥＤ素子１はそのパッケージの上面１ａにおいてその光量分布が最も高くなるため、ＬＥＤ素子１の上面１ａから導光板６の側面６ｂに光を導入するように配置される。
【０００６】
【発明が解決しようとする課題】前記のように照光モジュールにより表示素子を照光した場合、導光板６に入射したＬＥＤ素子１の照明光の明るさは、導光板６上の位置によりばらつきが生じる。即ち、図５において、導光板６のＬＥＤ素子１に近い領域ＢとＬＥＤ素子１から遠い領域Ｃとでは、明るさにおいて必然的に大きな差が生じるという問題がある。この問題は、導光板６の厚さＴが薄い場合、特に厚さＴが１．５ｍｍ以下の場合において著しいが、近年においては製品の小型化や薄型化が要求されるため、効果的な解決が望まれている。
【０００７】このような問題を回避するために、導光板６に入射したＬＥＤ素子１の照明光が拡散されるように種々の工夫がなされている。即ち、ベースプリント配線板３上の導光板６が配置される部分３ａに、蛍光性塗料

や白色塗料すなわち光反射率の高い塗料を塗布する方法、導光板６の底面部６ｃにヘアライン処理により細かい傷を設けて乱反射させる方法、または導光板６の底面部６ｃにマット処理により拡散面を形成する方法等がなされている。しかしながら、これらの方法によっても、照明光が図５の領域Ｃへ充分に入射・拡散されず、領域Ｂと領域Ｃとの明るさのばらつきは依然として残存するため、文字識別性の低下や目の疲れの原因にもなるという不都合がある。

【０００８】本発明は、このような事情に鑑みてなされたもので、導光板に入射された発光素子の照明光が、導光板の照光面においてばらつくことなく、均一な照明光により表示素子を照光することができる照光モジュールを提供することを目的としている。

【０００９】

【課題を解決するための手段】請求項１記載の照光モジュールでは、光源として一対の発光素子が対向して配置され、該一対の発光素子の間には光透過性樹脂からなる導光板が配置され、該導光板の側面から入射した前記発光素子の光が、前記発光素子の光軸方向と平行に形成された導光板の照光面から表示素子を照光するようにした照光モジュールにおいて、前記導光板の照光面に対して反対側の面には、該面の略中央部に凹型の反射部を形成するとともに、該反射部は縁部と最深部との間が凸曲面に形成されていることを前記課題の解決手段とした。

【００１０】請求項２記載の照光モジュールでは、請求項１記載の照光モジュールにおいて、前記導光板の照光面に対して反対側の面と前記反射部の最深部との間の距離が導光板の幅の約１０％であり、かつ前記反射部の光軸方向における長さが前記導光板の光軸方向の長さの約６０％であることを前記課題の解決手段とした。

【００１１】請求項３記載の照光モジュールでは、請求項１又は２記載の照光モジュールにおいて、前記導光板に形成される反射部の没入量が、前記導光板の厚さの５％～２０％の範囲としたことを前記課題の解決手段とした。

【００１２】請求項４記載の照光モジュールでは、請求項１ないし３のいずれかに記載の照光モジュールにおいて、前記発光素子の光軸を、前記導光板の厚さの中心線と、前記反射部の最深部における導光板の厚さの中心線との間に位置させたことを前記課題の解決手段とした。

【００１３】請求項５記載の照光モジュールでは、請求項１ないし４のいずれかに記載の照光モジュールにおいて、前記反射部の最深部が、反射部の凸曲面から連続する凹曲面に形成されていることを前記課題の解決手段とした。

【００１４】

【作用】請求項１記載の照光モジュールでは、一対の発光素子の間に導光板が配置されて、発光素子の光が導光板の側面から入射する。導光板に入射した一部の光は、照光面に対して反対側の面の略中央部に形成された反射部の曲面で反射され、この反射光が照光面の中央部から出射する。反射部の縁部と最深部との間を凹曲面に形成した場合には、反射部に照射された光を散乱する。一方、反射部の縁部と最深部との間を凸曲面に形成した場合には、反射部に照射された光全体を導光板の所定の位置に集光する。また、少なくとも反射部の表面に光反射率の高い塗料が塗布されているため、反射部の曲面において光の反射率が高くなる。

【００１５】請求項２記載の照光モジュールは、導光板の側面から入射されて反射部に照射された光を照光面中央部に集光する。

【００１６】請求項３記載の照光モジュールは、導光板に形成される反射部の深さが導光板の厚さの５％～２０％の範囲内である。反射部の深さが導光板の厚さの５％以下の場合は、反射部の曲面で反射される光が殆どない。また、反射部の深さが導光板の厚さの２０％以上の場合は、反射部が深いため反射光が照光面の中央部に集中せずに照光面全面に散らばる。

【００１７】請求項４記載の照光モジュールは、発光素子の光軸が導光板の厚さの中心線と反射部の最深部における導光板の厚さの中心線との間に位置する。発光素子の光軸が前記の範囲にあれば反射部の曲面で反射する光が適度に得られるが、前記の範囲外であれば反射部の曲面で得られる反射光が少ない。

【００１８】請求項５記載の照光モジュールは、発光素子から最深部に照射される光を、凹曲面で適切に散乱して照光面の全体に分散し、照光面全体の照度を偏在なく安定にする。

【００１９】

【実施例】以下、本発明による照光モジュールの一実施例を図面により説明する。なお、前記の図面と同じ構成要素については同一符号で示す。図１ないし図３は、本発明の一実施例を示す図である。この照光モジュールは、図１に示すように、光源であるＬＥＤ素子（発光素子）１がそれぞれ２個ずつ実装された一対のプリント配線板２が、ＬＥＤ素子１が実装された面を対向させて配置されている。この一対のプリント配線板２の間にはベースプリント配線板３が配置され、このベースプリント配線板３の両側方にはそれぞれ２箇所に孔４が形成されている。図１に示すように、これらの孔４内にプリント配線板２の結合用脚部２ａがそれぞれ挿入されるとともに、孔４周囲部の半田５によりベースプリント配線板３と一対のプリント配線板２とが固定されている。これら一対のプリント配線板２とベースプリント配線板３との組み合せによりコ字型のアングル部材が構成され、ベースプリント配線板３上に光透過性樹脂からなる導光板６が装着支持されている。なお、ベースプリント配線板３については、種々の形状をとり得るので、その形状は明示していない。

【００２０】前記導光板６は、厚さＴが０．５mm～１．５mm程度であり、図１に示すように、その側面６ｂがＬＥＤ素子１に対向するとともに、表示素子を照光するための照光面６ａがＬＥＤ素子１の光軸方向と平行に形成されている。この照光面６ａと反対側の面６ｃには、該面６ｃの略中央部に曲面形状の反射部７が形成されている。該反射部７は、中央部が最深部８になっている凹んだ形状であって、かつ該最深部８から等距離の部分と最深部８との間が凸曲面９に形成されてなっている。前記凸曲面９は、断面視、曲率半径一定の球面の一部分を形成する形状になっている。

【００２１】前記反射部７の深さは導光板６の厚さＴの５％～２０％の範囲内であることが好ましい。また、この反射部７の形成面積が導光板６の面６ｃの面積の２０％～８０％の範囲内であることが好ましい。さらに、前記凸曲面９は一定の曲率半径であることが成型上有利で好ましい。そして、反射部７の凸曲面９を含む面６ｃ全体には、白色の塗料（光反射率の高い塗料）が塗布されている。また、プリント配線板２上のＬＥＤ素子１の光軸は、導光板６の厚さＴの中心線と、反射部７の最深部８における導光板６の厚さｔの中心線との間に位置するように配置されている。

【００２２】なお、図３に示すように、最深部８は、前記凸曲面９に連続する凹曲面に形成されている。

【００２３】本実施例の照光モジュールを使用して光透過性液晶表示装置を照光する場合、図１に示すように、ＬＥＤ素子１の光が導光板６の側面６ｂから入射し、導光板６に入射した光が照明光となり、照光面６ａの前面に配置された光透過性液晶表示装置（図示略）を照光する。このとき、導光板６に入射された光の一部が反射部７により反射され、矢印方向に進んで照光面６ａから出射される。前記反射部７における入射光の反射は、凸曲面９に照射された入射光を入射角と等しい反射角で反射するが、凸曲面９が照光面６ａに対して凹面なので、反射光の反射方向を凸曲面９の曲率半径に応じた割合で集光する。反射部７は、入射光の集光位置が照光面６ａの中央部であって、照光面６ａの中央部のカンデラ値を保持することにより、照光面６ａ全体に照明光を均一に行き渡らせることができる。

【００２４】また、本実施例の照光モジュールは、面６ｃ方向に散乱する入射光を照光面６ａの外方に分散させることなく照光面６ａの中央部に導くので、照光面６ａにおける照明光の均一化が効率良くしかも容易である。また、凸曲面９の成型により、集光位置の設定も簡単であるので、ＬＥＤ素子１を導光板６の両側部に対向配置しない場合であっても、集光位置を照光面６ａの目的の位置に設定することにより、容易に照光面６ａへの照明光の均一化を図ることができ、照光モジュールの設計の自由度が向上する。なお、照光面６ａの最深部８の反射光が照射される部分は、最深部８の凹曲面により、反射光が収束することなく適切に散乱されるので、照光面６ａ全体が一定の照度で照光される。

【００２５】以下に、前記の構成の照光モジュールを製作し、その導光板６の照光面６ａにおける照明光を測定した実験例を記す。

実験例

導光板６は、横Ｗが４０mm、縦Ｄが３０mm、厚さＴが１．５mmに形成した。導光板６の面６ｃの反射部７は、最深部８の深さが０．３mm（導光板６の厚さ１．５mmの２０％）、直径が３０mm（面６ｃの面積の５９％）に形成した。そして、この導光板の面６ｃの全面には、白色の塗料を塗布した。また、各プリント配線板２上の２つのＬＥＤ素子１の間隔Ｘが１０mm、二つのプリント配線板２間の距離Ｙが４４mmになるように形成した。ＬＥＤ素子１としては、高輝度タイプ色調のイエローグリーンのＬＥＤ素子でチップ形状のパッケージ素子を使用した。ＬＥＤ素子１は１０mＡの電流を流して通電状態とした。

【００２６】基準とする照光モジュールは、導光板６の厚さＴが３．０mmであり、面６ｃに反射部７が形成されていない他は前記と同じ条件として製作した照光モジュールであり、この場合の照光面６ａ全体をターゲットとした測光数値（カンデラ値）を１．０とする。そして、前記の実験例の照光モジュールで導光板６の照光面６ａのカンデラ値を測定すると、図２の領域Ｂが１．３５であり、領域Ｃが０．７０であった。なお、比較実験として、導光板６の厚さＴが３．０mm、および１．５mmであり、導光板６の面６ｃに反射部７を形成しない以外は実験例と同じ条件の照光モジュールについて、照光面６ａのカンデラ値をそれぞれ測定した。導光板６の厚さＴが３．０mmの場合、図２の領域Ｂが１．３５であり、領域Ｃが０．８５であった。導光板６の厚さＴが１．５mmの場合、図２の領域Ｂが１．３０であり、領域Ｃが０．４２であった。前記の実験例より、本実施例の照光モジュールは、導光板６の厚さＴを薄くした場合でも、その照光面６ａにおけるカンデラ値が、導光板６の厚さＴが厚い場合と同じ程度に得られることがわかり、照明光のばらつきが少ない照光モジュールである。

【００２７】なお、照光モジュールの構造としては、図１ないし図３に示した構成の他に、ベースプリント配線板３と、ＬＥＤ素子１が実装されるプリント配線板２とを、フレキシブルプリント配線板で一体に結合し、フレキシブルプリント配線板部分で折り曲げて固定することにより、コ字型のアングル部材を構成してもよい。

【００２８】

【発明の効果】請求項１記載の照光モジュールは、一対の対向して配置された発光素子の間に光透過性樹脂からなる導光板が配置され、導光板の側面から入射した発光素子の光が、発光素子の光軸方向と平行に形成された導光板の照光面から表示素子を照光するようにした照光モ

ジュールにおいて、前記導光板の照光面に対して反対側の面には、該面の略中央部に凹型の反射部が形成されるとともに、該反射部は縁部と最深部との間が凸曲面に形成されていることを特徴とする。従って、導光板の側面から入射した発光素子の光の一部が反射部の曲面で反射されるとともに、反射部の表面に塗布された光反射率の高い塗料により反射されて分散又は所定の位置に集光されるため、照光面全体において明るさがばらつくことなく、均一な照明光が得られる。そして、表示素子が均一な照明光で照光されるため、表示装置においては文字識別性が良好であり、目の疲れも生じない。

【００２９】請求項２記載の照光モジュールは、請求項１記載の照光モジュールにおいて、前記導光板の照光面に対して反対側の面と前記反射部の最深部との間の距離が導光板の幅の約１０％であり、かつ前記反射部の光軸方向における長さが前記導光板の光軸方向の長さの約６０％であることを特徴とする。したがって、反射部は、前記凹曲面で反射した入射光を、ほぼ照光面の中央部に集光して、効率良く照光面の中央部のカンデラ値を上昇する。

【００３０】請求項３記載の照光モジュールは、請求項１又は２記載の照光モジュールにおいて、反射部の深さが導光板の厚さの５％～２０％の範囲内である。そのため、反射部で反射される光が適度に得られるとともに、照光面の中央部に反射光が集中することにより、発光素子から遠い照光面の中央部が明るくなり、照光面全体が均一な明るさになる。

【００３１】請求項４記載の照光モジュールは、請求項１ないし３記載の照光モジュールにおいて、発光素子の光軸が、導光板の厚さの中心線と反射部の最深部における導光板の厚さの中心線との間に位置するので、反射部において入射光が所望の光量で適度に反射する。そのため、照光面の中央部が反射光により明るさが増し、照光面の明るさにばらつきがなくなる。

【００３２】請求項５記載の照光モジュールでは、請求項１ないし４のいずれかに記載の照光モジュールにおいて、前記反射部の最深部が、反射部の凸曲面から連続する凹曲面に形成されていることを特徴とするから、反射部の最深部においても、光が収束することなく分散して、照光面全体を安定した照度で照光することができる。

【図面の簡単な説明】

【図１】　本発明の一実施例として示した照光モジュールの図２のＡＢ線における断面図である。

【図２】同照光モジュールの平面図である。

【図３】同照光モジュールの反射部の最深部を示す拡大断面図である。

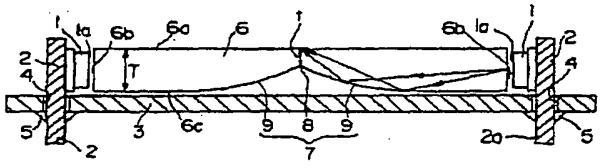
【図４】従来の照光モジュールの、図５のＡＢ線における断面図である。

【図５】同照光モジュールの平面図である。

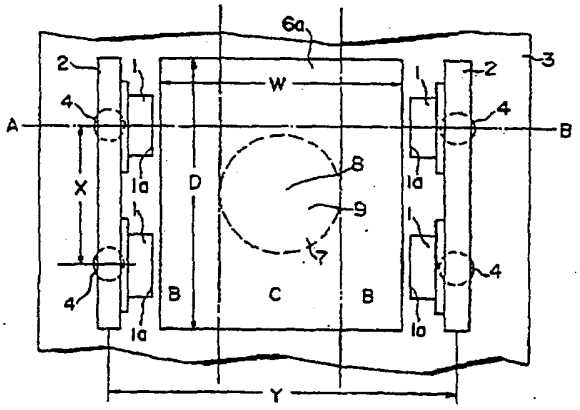
【符号の説明】

１　ＬＥＤ素子
６　導光板
６ａ　照光面
７　反射部
８　最深部
９　凸曲面

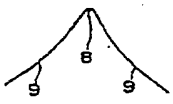
【図１】



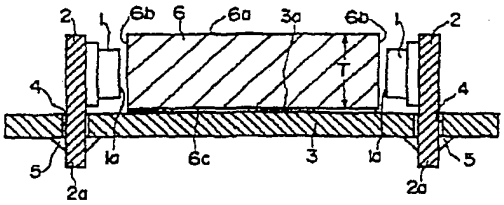
【図２】



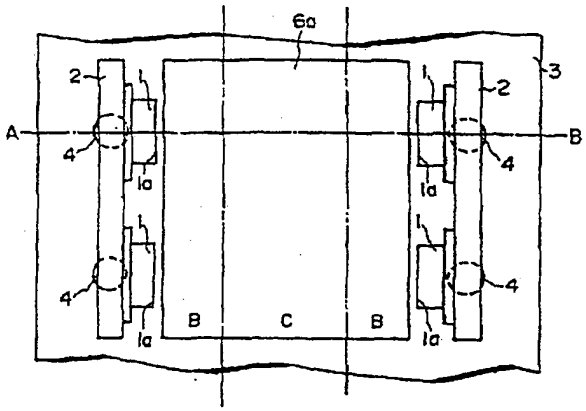
【図３】



【図４】


2
1
6b
6
6a
3a
6b
1
2
4
4
T
5
1a
6c
3
1a
5
2a
2a

【図５】


6a
3
2
1
1
2
A
B
4
1a
1a
4
1
1
4
4
B
C
B
1a
1a